ACP Chemistry ~~AP Psychology~~ / Ch. 7 Homework Quiz 1/26/17

1. Given: $m = 175\,g$, $V = 150\ km/hr$ Find λ

$$\lambda = \frac{h}{mv}$$

$$= \frac{6.626 \times 10^{-34}\ \cancel{kg} \cdot \frac{m^{\cancel{2}}}{\cancel{s^2}} \cdot \cancel{s}}{\left(175\,\cancel{g} \times \frac{\cancel{kg}}{10^3\,\cancel{g}}\right)\left(150\,\cancel{km}/\cancel{hr} \times \frac{10^3\,m}{1\,\cancel{km}} \times \frac{1\,\cancel{hr}}{3600\,\cancel{s}}\right)}$$

$$= \frac{6.626 \times 10^{-34}}{7.292} = 8.59 \times 10^{-35}\ m$$

The value of λ, $8.59 \times 10^{-35}\ m$, is so small it will not have an effect on the trajectory of the base ball.

2. a) Given $n = 3 \rightarrow n = 5$

$$\Delta E_{atom} = E_5 - E_3$$

$$= -2.18 \times 10^{-18}\ J \left[\left(\frac{1}{5^2}\right) - \left(\frac{1}{3^2}\right)\right]$$

$$= -2.18 \times 10^{-18}\ J\ (0.04 - 0.11)$$

$$= 1.55 \times 10^{-19}\ J$$

$$\lambda = \frac{hc}{\Delta E_{atom}} = \frac{(6.626 \times 10^{-34}\ J \cdot s)(3.0 \times 10^8\ m/s)}{1.55 \times 10^{-19}\ J}$$

$$= 1.28 \times 10^{-6}\ m \text{ or } 1280\,nm$$ absorbed ~~aborbed~~

2 b) Given $n=4 \longrightarrow n=2$

$$\Delta E_{atom} = E_2 - E_4$$

$$\Delta E_{atom} = -2.18 \times 10^{-18} J \left[\left(\frac{1}{2^2}\right) - \left(\frac{1}{4^2}\right) \right]$$

$$= -4.0\underline{8}7 \times 10^{-19} J$$

$$\lambda = \frac{hc}{\Delta E_{atom}} = \frac{(6.626 \times 10^{-34} J \cdot s)(3.00 \times 10^{8} m/s)}{-4.087 \times 10^{-19} J}$$

$$= \underset{4.86}{\cancel{1.03}} \times 10^{-7} m$$

visible region

c) Given n (initial) = 7, $\lambda = 397 nm$

$$\Delta E_{atom} = E_x - E_7$$

$$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} J \cdot s)(3.00 \times 10^{8} m/s)}{\left(397 nm \times \frac{m}{10^9 nm}\right)}$$

$$= 5.0\underline{0}7 \times 10^{-19} J$$

$$\Delta E_{atom} = -\Delta E_{photon} = -5.0\underline{0}7 \times 10^{-19} J$$

$$-5.0\underline{0}7 \times 10^{-19} J = -2.18 \times 10^{-18} J \left[\left(\frac{1}{x^2}\right) - \left(\frac{1}{7^2}\right) \right]$$

$$0.2297 = \left(\frac{1}{x^2}\right) - \left(\frac{1}{7^2}\right)$$

$$x^2 = 3.998, \quad x = 2$$

$$n=7 \longrightarrow n=2$$

3 a) $E_n = n^2 h^2 / 8 m L^2$

$$= \frac{n^2 \, (J \cdot s)^2}{8 \; kg \; m^2} = \frac{n^2}{8} \; \frac{\left(kg \cdot \frac{m^2}{\cancel{s^2}} \cdot \cancel{s}\right)^2}{kg \quad m^2}$$

$$= \frac{kg^2 \cdot \frac{m^4}{s^2}}{kg \cdot m^2} = kg \cdot \frac{m^2}{s^2} = J$$

b) $n = 1, n = 2, n = 3$, $L = 155\,pm$ Find E_1, E_2, E_3

$$E_n = n^2 h^2 / 8 m L^2$$

$$E_1 = \frac{1^2 (6.626 \times 10^{-34} J \cdot s)^2}{8 (9.11 \times 10^{-31} kg)\left(155\,pm \times \frac{1m}{10^{2} pm}\right)}$$

$$= 2.51 \times 10^{-18} J$$

$$E_2 = 2^2 [\quad\quad] = 1.00 \times 10^{-17} J$$

$$E_3 = 3^2 [\quad\quad] = 2.26 \times 10^{-17} J$$

$\Delta E \; \cancel{\lambda_1} = E_2 - E_1 = (1.00 \times 10^{-17} J - 2.51 \times 10^{-18} J)$

$$= 7.49 \times 10^{-18} J$$

$$\lambda = \frac{(6.626 \times 10^{-34} J \cdot s)(3.00 \times 10^8 m/s)}{7.49 \times 10^{-18} J}$$

$$= 26.5\,nm$$

3 b) $E_3 - E_1 = (2.25 \times 10^{-17} J - 1.00 \times 10^{-17} J)$

$= 1.26 \times 10^{-17} J$

$$\lambda = \frac{(6.626 \times 10^{-34} J.s)(3.00 \times 10^{8} m/s)}{1.26 \times 10^{-17} J}$$

$= 15.8 nm$

wavelength lie in UV region

4. 70% of the energy of the universe lies in empty space and accounts for the observation that the rate of expansion of the universe is increasing.